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Introduction

Repeat-breeding females were classified as those females nonpregnant after two consecutive breeding seasons of 45 to 60 days' duration. Females were either naturally mated or artificially inseminated and exposed to clean-up bulls. Each year, approximately 7,000 beef females (6,803 to 7,374) at the Research Center were bred by either artificial insemination (approximately 2,000 females) and/or exposure to single or multiple sires in two breeding periods of 45 to 60 days' duration. Breeding periods were either May 15 to July 15 or November 1 to December 31 during 1979 through 1982. During the four years, 165 heifers and 241 cows (clinically free of diseases and 2 to 12 yr of age) of various straight and crossed breeds were classified as repeat breeders. Contemporary cows (102 head, clinically free of diseases and 3 to 11 yr of age) of various straight and crossed breeds, which produced a calf in the previous calving season, served as controls. Statistics on conception rate, calf survival, and number of repeat breeders are listed in Table 1. Total calf crop loss (28 pct average over four yr) resulted from 52 percent of the females being open (not pregnant) at palpation, while 48 percent of the females were pregnant but had prenatal (9.0 pct) and postnatal (39 pct) losses. The percentage of females classified as repeat breeders from the total females exposed was low (1.0 to 1.7). However, the percentage of females classified as repeat breeders from those females palpated nonpregnant averaged 10. Although repeat breeding was not a big problem in the Research Center herds, it may be a problem in other herds. Various causes and influences were investigated in the 406 repeat breeders in an attempt to determine if repeat breeding was due to one or several causes. Factors investigated in the beef cows and heifers were: previous calving difficulty in cows, fertilization failure, embryonic mortality, hormonal dysfunction, chromosomal abnormalities, and uterine secretions.

Procedure

At each parturition, a calving difficulty score was assigned to each cow. Therefore, records from cows which were classified as repeat breeders and controls were analyzed for calving difficulty score, weaning percentage, and calving efficiency. The scoring system for calving difficulty is shown in Table 2. Percentage parturition difficulty was calculated by counting the number of calving difficulty scores of 3 or more and dividing by the number of parturitions per cow, multiplied by 100. Percentage abnormal presentation or posture was calculated by counting the number of calving scores of 8 divided by the number of parturitions per cow, multiplied by 100. Percentage calves weaned equaled number of calves weaned divided by total calves born per cow, multiplied by 100. Percentage calving efficiency equaled number of calves per cow divided by cow-age-minus-1, multiplied by 100.

Before slaughter all repeat-breeder and control females were placed with multiple sires of either the Charolais or Simmental breed and mated. Estrous behavior was observed twice daily from 7 to 9 a.m. and 4 to 6 p.m. All females were slaughtered on days 2 to 51 postmating and their reproductive tracts collected for anatomical information, pregnancy determination, and uterine secretions. Blood samples were collected at days 3, 6, or 9 in the same females or at either days 3, 6, or 9 in different females. In a smaller group of controls (5) and repeat breeders (6), more frequent blood samples were collected, starting from estrus until slaughter at days 8 to 10. The blood serum was analyzed for progesterone, estradiol-17β, and luteinizing hormone concentration using radioimmunological procedures.

Preimplanted and early attached embryos were flushed from the oviduct and uterine horn ipsilateral (same side) to the corpus luteum using physiological saline or phosphate-buffered saline. The flushings were searched for an oocyte or embryo. Upon finding an oocyte or embryo, it was examined for fertilization and/or morphological development and classified as normal developing embryo, degenerate or degenerating embryo, or unfertilized oocyte. If no oocyte or embryo was found, the female was designated as a "nonrecovery" female. The uterine flushings from females less than 25 days into gestation were analyzed for protein, zinc, and calcium content. Fetuses 25 days or older were dissected from the uterine horn and examined for normal development.

In 133 repeat-breeder females, a jugular vein blood sample was collected in heparinized syringes. Peripheral blood lymphocytes were cultured, and chromosome metaphase spreads were prepared. The metaphase spreads were examined for chromosomal abnormalities under the microscope at 650X or higher magnification.

Results

More parturition (calving) difficulties ($P<.05$) were found in the repeat breeders (194/639 = 30.4 pct) than controls (57/392 = 14.5 pct) Table 2. The percentage of parturition difficulties did not differ when each group was heifers (first calving) as calving difficulty percentage was 133/241 = 47.6 and 47/102 = 46.1, respectively, for the repeat breeders and controls. The repeat breeders (61/398 = 15.3 pct) had 4.5 times more difficulties with subsequent parturitions than controls (10/290 = 3.4 pct). Besides female age, dam breed influenced parturition difficulties. Looking at abnormal presentation only, repeat breeders had significantly more abnormal presentations than controls (Table 2). Although the percentage of calves weaned did not differ statistically between the controls (87.4) and repeat breeders (78.4), the trend favored the control females. Calving efficiency was higher ($P<.01$) in the control (80.2 pct) than the repeat-breeder group (65.8 pct). This increased calving efficiency in the control population was expected because of the definition of the repeat breeder, since repeat breeders missed one or more calvings before becoming part of the experimental population. Several factors like size, breed, and age of female, sire of calf, size of pelvic area, sex of calf, or hormonal asynchrony may have contributed to increased parturition difficulties in the repeat-breeder population.

The examination of the reproductive tracts indicated that repeat breeders (10.9 pct) had more anatomical defects than controls (0.0 pct). Although 3.6 percent of the repeat-breeder females failed to ovulate, this percentage was not different from control females (2.9 pct). Embryo and fetal development was lower ($P<.05$) in repeat breeders than controls (Table 3), and no recovery of either an oocyte or embryo was higher ($P<.05$) in the repeat breeders than controls. No differences were observed in degenerate embryos or in unfertilized oocytes between the groups.

Only the number of .03937 to .11811 in diameter follicles differed between the repeat breeders (26.3) and controls (39.1). No differences were found in ovarian weights, corpus luteum weights, or in the number of .15748 to .27559 in and greater than .31496 in diameter follicles and corpora albicantia. Corpus luteum weights were influenced by pregnancy status with heavier corpora lutea in females with normal embryonic develop-

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ment (.16 oz) compared to females with degenerate embryos or unfertilized oocytes (.13 oz) or nonrecovery of either an oocyte or embryo (.14 oz). Corpora lutea on the right side (.16 oz) were heavier than the left side (.12 oz). Ovulation occurred 60 percent of the time on the right ovary.

Total protein (24.0 *vs* 25.9 mg), zinc (2.1 *vs* 2.2μ g), and calcium (16.8 *vs* 19.7 μg) content of uterine flushings did not differ between control and repeat-breeder females, but days postmating significantly ($P<.05$) modulated protein, zinc, and calcium content. Progesterone content of uterine flushings between control (252.8 pg) and repeat-breeder females (107.7 pg) was not different statistically because the sample variability was large.

Progesterone content of peripheral serum between the two groups was similar on day 3 but differed ($P<.05$) on day 6 with controls (2.78 ng/ml) having higher concentrations than repeat breeders (1.91 ng/ml). Values on day 9 did not differ between groups. Luteinizing hormone (LH) peak heights did not differ between the groups (C, 71.8 *vs* RB, 94.3 ng/ml). Although the interval from estrus to the LH peak was not statistically different between groups because of sample variability, the mean interval for the controls (13.2 h) was less than the repeat breeders (21.3 h). The ratio of estradiol-17β to progesterone did not differ statistically between groups. However, the controls tended to have lower progesterone and higher estradiol-17β values compared to the repeat breeders. This could be interpreted to mean that the repeat breeders may be more asynchronous in their hormone secretion.

Various attempts were made to increase progesterone by giving gonadotropin releasing hormone or human chorionic gonadotropin at estrus to enhance and/or hasten corpus luteum formation and progesterone secretion. Pregnancy rate was not increased, but progesterone concentrations were increased in the repeat-breeder heifers. The addition of aspirin to the feed, as well as giving exogenous progesterone, did not increase pregnancy rate in the repeat-breeder females. It appears that serum progesterone concentrations may vary, but pregnancy is not increased in repeat breeders by raising peripheral levels of progesterone.

Analyses of the chromosomes indicated that 19 of 133 (14.3 pct) repeat-breeder females had a gross chromosomal aberration. These anomalies were the presumptive 1/29 translocation (10 females) and sex chromosome anomalies (9 females). The 1/29 translocation is where chromosome 1 joins chromosome 29 to make a large metacentric chromosome. Females with the 1/29 translocation have 59 instead of 60 chromosomes.

These investigations indicated that repeat breeding occurs in a low incidence (1.0 to 1.7 pct) in the Research Center's herds and is the result of several factors. The causes are classified in Table 4. Calving difficulties may influence a female to become a repeat breeder or may be another indicator of hormonal dysfunction. Excluding females with anatomical and chromosomal aberrations, ovarian dysfunction appears to be the largest cause of repeat breeding; however, pituitary factors could not be totally eliminated.

Table 1.—Calf crop losses to weaning (spring and fall calving seasons combined) and number of repeat-breeder females

	1979-80[a]	1980-81	1981-82	1982-83
Number females exposed to mating or AI	7,374	7,132	6,803	7,001
Percentage loss due to:				
a) Not pregnant at palpation	13.5	14.1	14.1	15.7
b) Palpated pregnant but failed to calve	1.7	2.4	3.2	2.6
c) Calf loss before 72 h[b]	13.4	6.2	7.1	9.1
d) Calf loss after 72 h[b]	1.6	1.5	2.0	3.7
Total loss	30.2	24.2	26.4	31.1
Percentage of total loss due to not pregnant at palpation	44.7	58.3	53.4	50.5
Number repeat-breeder females[c]	72	101	115	118
Percentage repeat breeder of total females exposed	1.0	1.4	1.7	1.7

[a]Year females exposed—year calved.
[b]Time calves died after parturition.
[c]Repeat breeder was a female not pregnant after two consecutive breeding seasons of 45 to 60 days' duration. Palpation was conducted at least 60 days after the end of the breeding season. All females had the opportunity to have 2 to 5 estrous cycles/breeding season or at least 4 to 10 estrous cycles to become pregnant before being classified as a repeat breeder.

Table 2.—Number and percentage[a] of parturitions by calving difficulty scores

Group		Parturitions/ number cows	Calving difficulty scores[b] 1	2	3	4	5	6	7	8
Control[c]	1st	102/102	55 (53.9)	5 (4.8)	5 (4.9)	20 (19.6)	2 (2.0)	8 (7.8)	4 (3.8)	3 (2.8)
	All	392/102	325 (82.9)	10 (2.6)	6. (1.5)	24 (6.1)	2 (0.5)	8 (2.0)	7 (1.8)	10 (2.6)
Repeat	1st	241/241	100 (41.5)	7 (2.9)	8 (3.3)	57 (23.6)	11 (4.6)	11 (4.6)	38 (16.2)	8 (3.3)
Breeder[c]	All	639/241	432 (67.6)	13 (2.0)	10 (1.6)	78 (12.2)	17 (2.7)	14 (2.2)	43 (6.7)	32 (5.0)

[a]Numbers in parentheses are percentages.
[b]1 = calved unassisted, 2 = assistance given by hand, 3 = assistance with mechanical calf puller—little difficulty, 4 = assistance with mechanical calf puller—slight difficulty—no injury to cow or calf, 5 = assistance with mechanical calf puller—moderate difficulty—minor injury to cow or calf, 6 = assistance with mechanical calf puller—major difficulty—severe hiplock, usually more than 30-min delivery, 7 = caesarean birth, 8 = abnormal presentation or posture.
[c]Data for parous females only. All control females were parous while the repeat breeders were both parous (241) and nonparous (165).

Table 3.—Pregnancy status in control and repeat-breeder females at slaughter

Group	No. females	Pregnancy status (pct) Normal embryo	Degenerate embryo	Unfertilized oocyte	No recovery
Control	99	76.8	9.1	6.0	8.1
Repeat Breeder	336	42.3	8.9	8.0	40.8

Table 4.—Causes and frequency of cause for repeat breeding in beef cattle

Cause	Frequency (pct)
Reproductive tract anatomical aberration	10.9
Anovulation	3.6
Chromosomal abnormalities	14.3
Nonrecovery of either an oocyte or embryo	34.7
Endocrine dysfunction and other causes	36.5